

Remarks

Objections to Claims

Claims 23 – 26 were objected to for various grounds, which have each been responsively amended.

Rejection Pursuant to 35 USC 102

Claims 1 - 4, 8 - 9, 13 - 17, 20 - 22, and 26 were rejected as being anticipated by **Kurosawa** (US 6,134,369). **Kurosawa** was cited as disclosing an optical device with all the limitations set forth in the claims, including: a planar photonic crystal slab in which an array of holes is defined (Fig. 2); a waveguide defined by a line defect defined in the slab (Fig. 3); the line defect created by a geometric perturbation of at least a first set of holes with respect to a second set of holes to create at least one guided mode of light propagation in the waveguide which exhibits reduced vertical and lateral losses (abstract); increased coupling of light into the slab (abstract); the geometric perturbation being a positional displacement of the first set of holes with respect to the second set of holes in a predetermined direction (Fig. 2-3); the first and second set of holes having same diameters (Fig. 2).

The waveguide in **Kurosawa** is **not** defined by a line defect defined in the array of holes in said slab as required by the claim. **Kurosawa** states at col. 2, line 48 et.seq.:

“FIGS. 1 and 2 illustrate a first embodiment of the invention. In this embodiment, the waveguide is formed in a transmissive layer 200 which is deposited on top of a substrate 202. The transmissive layer 200 has an {sic} refractive index n_1 while the substrate has a refractive index n_2 and the atmosphere surrounding the

substrate 202 and has a refractive index of n_3 . “

“Four slots 210 are machined into the transmissive layer using an ultrafast laser, for example a picosecond or femtosecond laser. **These slots define the straight-line portions of the waveguide** because the refractive index of the atmosphere differs from that of the transmissive layer 200. In addition, because the slots 210 are machined using an ultrafast laser, they may be smooth and straight and may have side walls that are substantially perpendicular to the plane of the transmissive layer 200.”

In all of the figures of **Kurosawa** the waveguide is not defined by an array of holes in the crystal, but by a single pair of opposing slots. Only the bend in the waveguide has any partial array of holes associated with it, which not referenced as an array, but as a photonic bandgap element.

There is no line defect defined in the collection of holes which comprise **Kurosawa's** photonic bandgap element in Fig. 3. Consequently, there is no disclosure whatsoever in **Kurosawa** about any line defect created by a geometric perturbation of at least a first set of holes in the array with respect to a second set of holes in the array to create at least one guided mode of light propagation in the waveguide which exhibits reduced vertical and lateral losses. The abstract of **Kurosawa** makes no mention whatsoever of any line defect, of any geometric perturbation, of any sets of holes in any array, of any guided mode of light propagation, of any reduced vertical and lateral loss, or of any increased coupling of light into the slab.ⁱ **Kurosawa** in fact discloses very little of how the collections of holes 221 and 223 in Figs. 2 – 5 are arranged among themselves other than to state that they are triangular packings. There is no disclosure whatsoever concerning the spatial relationship of collection 221 of holes to collection 223.

It cannot be maintained that **Kurosawa** discloses each and every element of

claim 1. Similarly, claims 2 - 4, 8, 9 and 13 are apparatus claims which add additional elements and limitations which are not in combination with claim 1 disclosed by **Kurosawa**. Claim 14 is a method claim analogous to claim 1 and each and every element of claim 14 is not disclosed by **Kurosawa** for the same reasons. Claims 15 - 17, 20 - 22 and 26 are method claims which add additional elements and limitations which are not in combination with claim 14 disclosed by **Kurosawa**.

Claims 1, 10 - 12, 14, and 23 - 25 were rejected as being anticipated by **Cotteverte et al** US Patent Application 2002/0048422 A 1. **Cotteverte** was cited as disclosing an optical device with all the limitations set forth in the claims, including: a planar photonic crystal slab in which an array of holes is defined (Fig. 21); a waveguide defined by a line defect defined in the slab, the line defect being created by a geometric perturbation of at least a first set of holes with respect to a second set of holes to create at least one guided mode of light propagation in the waveguide which exhibit reduce vertical and lateral losses, increased coupling of light into the slab, and closer matching of frequencies of eigen modes of the optical device coupled to the waveguide (paragraph 0019-0025); the geometric perturbation being created by increasing or decreasing the diameter of the first set of holes in the array relative to the second set of holes comprising the remainder of the array (Fig. 21, 251).

Cotteverte does show a planar photonic crystal slab in which an array of holes is defined and in which a waveguide is defined by a line defect defined in the array. A line defect is simply a regular array in which a line of holes has been omitted, but the array is otherwise undisturbed. However, **Cotteverte** does **not** describe the creation of the

line defect being by a geometric perturbation of two sets of holes in the array. There is **no teaching** in **Cotteverte** that suggest that any perturbation exists such that at least one guided mode of light propagation in the waveguide which exhibit reduce vertical and lateral losses, increased coupling of light into the slab, and closer matching of frequencies of eigen modes of the optical device coupled to the waveguide.

Paragraph 0019 of **Cotteverte** simply states that there is a regular array of holes and a line defect in that regular array is provided, i.e. a line of holes is omitted. Paragraph 0020 of **Cotteverte** adds nothing whatsoever about the nature of the line defect, but discusses inclusion of movable rods inserted into the holes. Paragraph 0021 of **Cotteverte** adds nothing whatsoever about the nature of the line defect, but discusses inclusion of fluid being pumped into the holes with a micropump. Paragraph 0022 of **Cotteverte** adds nothing whatsoever about the nature of the line defect, but discusses the benefits of including active devices in the photonic crystal. Paragraphs 0023 - 0025 of **Cotteverte** adds nothing whatsoever about the nature of the line defect, but are meaningless boilerplate.

Fig. 21 of **Cotteverte** does show holes of different sizes used on different sides of the line defect. **Cotteverte** state at paragraph 0071:

“In an alternative embodiment of a Mach-Zehnder interferometer, shown in FIG. 21, the first waveguide arm segment 176 and the second waveguide arm segment 182 are defined by planar photonic crystal structures having different parameters. For example, the first waveguide arm segment 176 is defined by a first planar photonic crystal structure, having a column radius of r_1 and a pitch of p_1 . In this example, the first planar photonic crystal structure also defines the input waveguide segment 170 and the output waveguide segment 188. The second arm waveguide segment 182 is defined by a second planar photonic crystal structure, different from the first planar photonic crystal structure, and having a column radius of r_2 and a pitch of p_2 . As described above, an optical signal propagating through the first arm waveguide segment 176 will be effected {sic} differently than an optical signal propagating through the second arm

waveguide segment 182, depending on the degree of actuation. Thus, actuation of the dimensional actuating device may be used to control the intensity of the recombined optical signal emerging from the device at output end 192 of the output waveguide segment 188. “

There is no discussion here whatsoever of the line defect 176 and how it is to be dimensioned. The line defect 176 is not defined by holes of different sizes, which are used instead as active devices at that location in the waveguide. Therefore, the geometric perturbation defining the line defect is not created by increasing or decreasing the diameter of the first set of holes in the array relative to the second set of holes comprising the remainder of the array.

It cannot be maintained that **Cotteverte** discloses each and every element of claims 1 or 14 and for the reasons set out above claims 10 - 12, and 23 – 25 are similarly not anticipated.

Rejection Pursuant to 35 USC 103

Claims 5 – 7, 18 and 19 are rejected as being obvious over **Kurosawa**. **Kurosawa** was cited as disclosing an optical device with all the limitations set forth in the claims, except it does not explicitly specify positional displacement values. The Examiner contended that it is well known in the art to determine optimal positional displacement values for guiding light signals with minimal optical loss. Therefore, it would have been obvious to a person of ordinary skill in the art to arrange the set of holes in **Kurosawa** device to reflect optimal positional displacement values. It would be desirable to have an optical device with a minimal optical loss.

The premise based on **Kurosawa** cannot be assumed as is the case in this

rejection. **Kurosawa** does not disclose an optical device with all the limitations set forth in the claims 1 and 14, let alone the claimed optical device without the positional displacement values. Since the premise is false in this case, it cannot then be argued that it is well known how to optimize what is not disclosed. To repeat, the waveguide in **Kurosawa** is **not** defined by a line defect defined in the array of holes. There is **no** line defect defined in the collection of holes used in the bend in **Kurosawa**. There is **no** disclosure whatsoever in **Kurosawa** about any line defect created by a geometric perturbation of at least a first set of holes in the array with respect to a second set of holes in the array to create at least one guided mode of light propagation in the waveguide which exhibits reduced vertical and lateral losses.

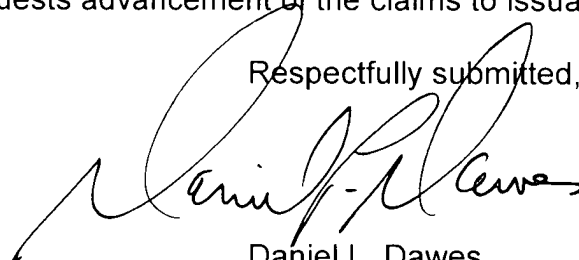
Even using **Cotteverte**, which does show a line defect, does not help the Examiner's proposition, because there is no disclosure or discussion of any kind whatsoever in **Cotteverte** of how any geometric perturbation of at least a first set of holes in the array with respect to a second set of holes in the array to create at least one guided mode of light propagation in the waveguide which exhibits reduced vertical and lateral losses. **Cotteverte** only discusses filling the holes adjacent to the line defect with rods or fluid and is silent and oblivious to any manipulation for any effect of the line defect itself.

Given that neither **Kurosawa** nor **Cotteverte** even contemplate manipulating the geometry of the line defect for any reason, it is clear that specific positional displacement values of subsets of holes in the arrays do not suddenly become obvious choices to make good waveguides in the manner as disclosed in the various bandgap diagrams of the application. In this case **Cotteverte** is not cited as a section 103

reference. Even if it were known that geometric manipulation of the line defect could result in some advantageous result, exactly how and how much such geometric manipulation would give good or bad results is completely nonobvious from the art.

The applicant respectfully requests advancement of the claims to issuance.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Daniel L. Dawes", is written over the typed name and contact information.

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ⁱ The abstract states:

“A compact optical waveguide employs a photonic band gap element as a reflector to enable a light beam to be reflected at angles greater than the critical angle. The photonic band gap device is a two-dimensional array of columnar holes formed in the substrate the holes are filled with air or another material having a different dielectric constant than the substrate. The optical waveguide forms a right angle bend and first and second photonic band gap devices are formed on both the inside and outside angles of the bend to deflect light which is incident on the waveguide at an angle greater than a critical angle defined by the materials that constitute the optical waveguide. The columnar holes of the photonic band gap element have a diameter of approximately one-half wavelength and are arranged in a triangular packing having an inter-column separation of approximately one-half wavelength of the light which is to be transmitted through the waveguide. The optical waveguide is formed by depositing a transmissive material having a first refractive index on top of a substrate which has a second refractive index and, using an ultrafast laser, cutting channels into the transmissive material to define straight portions of the waveguide and, also using the ultrafast laser, cutting the columns into the transmissive material to define the photonic band gap elements. In another example of the invention, the optical waveguide is formed by depositing a transmissive material having a first refractive index into a channel in a substrate which has a second refractive index and, using an ultrafast laser to cut the columns into the transmissive material to form the photonic band gap elements. In a final example of the invention, the optical waveguide is formed by depositing a transmissive material having a first refractive index which forms a channel on top of a substrate which has a second refractive index and, using an ultrafast laser to cut the columns into the transmissive material to form the photonic band gap elements. “